

1. (Previously presented) A method for fabrication of ferroelectric capacitor elements of an integrated circuit comprising the steps of:

deposition of an electrically conductive bottom electrode layer;  
deposition of a layer of ferroelectric dielectric material;  
annealing the layer of ferroelectric dielectric material to form perovskite phases with a first anneal;

deposition of an electrically conductive top electrode layer;  
annealing the layer of ferroelectric dielectric material with a second anneal, the second anneal changing the layer of ferroelectric material into grains having a columnar structure, being performed by rapid thermal annealing and performed after the step of deposition of an electrically conductive top electrode layer;

etching the electrically conductive top electrode layer; and  
annealing the layer of ferroelectric dielectric material with another anneal after etching the electrically conductive top electrode layer.

2. (Original) The process of Claim 1, wherein the electrically conductive bottom electrode layer comprises a noble metal.

3. (Original) The process of Claim 2, wherein the electrically conductive bottom electrode layer comprises platinum.

4. (Original) The process of Claim 1, wherein the ferroelectric dielectric layer comprises PZT.

5. (Original) The process of Claim 1 wherein the electrically conductive top electrode layer comprises a noble metal oxide.

6. (Original) The process of Claim 5 wherein the electrically conductive top electrode layer comprises Iridium Oxide.

7. (Original) The process of Claim 5 wherein the first anneal comprises a rapid thermal anneal at a temperature between five hundred twenty five and six hundred degrees celsius.

8. (Original) The process of Claim 7, wherein the first anneal is performed at a temperature of approximately five hundred seventy five degrees celsius for a time between sixty and one hundred twenty seconds.

9. (Original) The process of Claim 7 wherein the second anneal is performed at a temperature of between seven hundred and seven hundred fifty degrees celsius.

10. (Original) The process of Claim 9, wherein the second anneal is performed at a temperature of approximately seven hundred twenty five degrees celsius for a duration of greater than ten seconds.

11. (Original) The process of Claim 10, wherein the second anneal is performed for a duration of approximately twenty seconds.

12. (Previously presented) A method for fabrication of ferroelectric capacitor elements of an integrated circuit comprising the steps of:

- deposition of an electrically conductive bottom electrode layer comprising a noble metal;

- deposition of a layer of ferroelectric dielectric material;

- annealing the layer of ferroelectric dielectric material to form perovskite phases with a first anneal;

- deposition of an electrically conductive top electrode layer comprising a noble metal oxide; and

- annealing the layer of ferroelectric dielectric material with a second anneal, the second anneal changing the layer of ferroelectric material into grains having a columnar structure, being performed in an environment comprising a mixture of oxygen and inert gas, the oxygen having partial pressure of less than five percent of one atmosphere and performed after the step of deposition of an electrically conductive top electrode layer.

13. (Original) The process of Claim 12, wherein the electrically conductive bottom electrode layer comprises platinum.

14. (Original) The process of Claim 12, wherein the ferroelectric dielectric layer comprises PZT.

15. (Original) The process of Claim 12 wherein the first anneal is performed in an environment comprising oxygen, the oxygen having partial pressure of less than ten percent of one atmosphere.

16. (Original) The process of Claim 15 wherein the first anneal is performed in an environment comprising oxygen at a partial pressure of approximately five percent.

17. (Original) The process of Claim 15 wherein the first anneal is performed in an environment comprising a mixture of oxygen and inert gas.

18. (canceled)

19. (Previously presented) The process of Claim 12 wherein the second anneal is performed in an environment comprising oxygen at a partial pressure of approximately one percent.

20. (Previously presented) The process of Claim 12 wherein the first anneal is performed in an environment comprising a mixture of oxygen and inert gas.

21. (Previously presented) The process of Claim 12, further comprising the step of:

depositing an encapsulation layer; and

wherein the second anneal is performed after the step of depositing an encapsulation layer.

22. (Original) The process of Claim 21 wherein the second anneal is performed at a temperature of between seven hundred and seven hundred fifty degrees celsius for a time not less than ten seconds.

23. (Original) The process of Claim 22 wherein the ferroelectric dielectric layer comprises PZT.

24. (Original) The process of Claim 23 wherein the step of depositing the ferroelectric dielectric layer is performed by sputtering.

25. (canceled)

26. (canceled)

27. (Previously amended) A method for fabrication of ferroelectric capacitor elements of an integrated circuit comprising the steps of:

deposition of an electrically conductive bottom electrode layer;

deposition of a layer of ferroelectric dielectric material by a sputtering method;

annealing the layer of ferroelectric dielectric material to form perovskite phases with a first anneal;

deposition of an electrically conductive top electrode layer; and

annealing the layer of ferroelectric dielectric material with a second anneal, the second anneal changing the layer of ferroelectric material into grains having a columnar structure and performed after the step of deposition of an electrically conductive top electrode layer.

28. (Previously presented) The process of Claim 27, wherein the ferroelectric dielectric layer comprises PZT.

29. (Previously presented) The process of Claim 27 wherein the electrically conductive top electrode layer comprises iridium oxide.

30. (Previously presented) A method for fabrication of ferroelectric capacitor elements of an integrated circuit comprising the steps of:

deposition of an electrically conductive bottom electrode layer;

deposition of a layer of ferroelectric dielectric material;

annealing the layer of ferroelectric dielectric material to form perovskite phases with a first anneal;

deposition of an electrically conductive top electrode layer comprising amorphous iridium oxide; and

annealing the layer of ferroelectric dielectric material with a second anneal, the second anneal changing the layer of ferroelectric material into grains having a columnar structure and performed after the step of deposition of an electrically conductive top electrode layer.

31. (Previously presented) The process of Claim 30, wherein the ferroelectric dielectric layer comprises PZT.